

## ANCIENT OBSTETRIC HAZARDS AND FEMALE MORTALITY

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IT is generally agreed by physical anthropologists who have had much experience of early historic or prehistoric skeletons that, on average, the women died at a younger age than the men. Many ancient burial grounds have been excavated from all over the world and it is uncommon to find any exceptions to this. The difference between male and female mean ages at death varies, but it is often approximately four to six years; this seems to be independent of the actual age at death. Table I shows a few sample populations selected from sites which are widely scattered geographically and which range in time from the Neolithic to the Middle Ages. The average difference here between male and female ages is approximately five years. Many more groups with similar differences could be produced; exceptions to this rule, when found, are usually in small populations of less than a dozen persons—far too few to afford a statistically meaningful result.

Alternatively, these differences may be expressed as the male or female life expectancy at some selected age already attained, e.g., 15 or 20 years. Table II does this for a few groups. Only within quite recent times have women started to outlive men by several years, and even this is largely limited to populations with a European type of society.

The figures given in Tables I and II are based on osteological considerations. However, following MacDonell's pioneer article<sup>1</sup> in *Biometrika*, Szilágyi used documentary evidence.<sup>2</sup> He estimated mean ages at death by utilizing 24,848 epitaphs of the Roman era classified into 48 cities and regions. In one of his series there was no difference between the sexes. In seven of the 48 areas the mean age of female deaths exceeded that of males from 0.2 to 1.7 years (average 0.9 years). In the remaining 40 series male longevity exceeded that of females by an average of 5.8 years—in seven of these groups it was by more than 10 years. There are, of course, difficulties and uncertainties in relying on

TABLE I. AGE AT DEATH OF MALES AND FEMALES

<i>Series</i>	<i>Period</i>	<i>Investigator</i>	<i>Males (Years)</i>	<i>Females (Years)</i>	<i>Difference</i>
Moravia	Neolithic	Jelinek <sup>18</sup>	34.8	32.3	2.5
Anatolia	Chalcolithic	Senyurek <sup>19</sup>	35.8	27.9	7.9
Çatal Huyuk	6300 B.C.	Angel <sup>20</sup>	34.0	30.0	4.0
Lerna	1750 B.C.	Angel <sup>20</sup>	37.0	31.0	6.0
Athens and Corinth	650-350 B.C.	Angel <sup>20</sup>	45.0	35.0	10.0
Egypt	Roman	Senyurek <sup>21</sup>	41.9	30.6	11.3
Cirencester	Romano-British	Wells*	40.8	36.6	4.2
Caister-on-Sea	Middle Saxon	Wells*	36.8	31.7	5.1
Caerwent	8th-12th centuries A.D.	Wells*	31.6	31.7	+0.1
Thetford	Late Saxon	Wells <sup>9</sup>	38.1	30.4	7.7
North Elmham	Late Saxon	Wells*	38.2	35.8	2.4
Monkwearmouth	Late Saxon-Medieval	Wells*	40.8	37.6	3.2
Nové Zámky	Avars	Stoukal et al. <sup>22</sup>	43.0	40.0	3.0
Libice	9th-11th centuries A.D.	Hanáková <sup>25</sup>	44.8	43.8	1.0
Josefov	9th-11th centuries A.D.	Hanáková et al. <sup>23</sup>	46.2	40.8	5.4
Texas Indians	Pre-Columbiain	Goldstein <sup>17</sup>	41.0	33.9	7.1

\*Unpublished.

TABLE II. EXPECTATION OF LIFE AT THE AGE OF 20 YEARS

<i>Series</i>	<i>Period</i>	<i>Investigator</i>	<i>Males (Years)</i>	<i>Females (Years)</i>	<i>Difference (Years)</i>
Neanderthal	Paleolithic	Vallois <sup>24</sup>	15.0	5.0	10.0
	Upper Paleolithic	Vallois <sup>24</sup>	15.5	9.8	5.7
Vassilievka III	Mesolithic	Acsádi et al. <sup>7</sup>	23.9	20.3	3.6
	Mesolithic	Vallois <sup>24</sup>	8.6	6.0	2.6
Fofonovo	Mesolithic-Neolithic	Acsádi et al. <sup>7</sup>	35.8	22.7	13.1
Halimba Cseres	Medieval	Acsádi et al. <sup>7</sup>	49.8	45.4	4.4
Zalavar Castle	Medieval	Acsádi et al. <sup>7</sup>	48.9	46.6	2.3
Flad-Kerpuzta	Medieval	Acsádi et al. <sup>7</sup>	47.1	46.4	0.7

these funerary inscriptions, just as there are difficulties in assessing age from skeletons, but the totality of the evidence leaves no doubt that men usually lived longer than women.

In prehistoric communities and in later groups before reliable demographic data became available, it was not possible to explain with any certainty this sexual difference in mortality. In the absence of accurate certification the cause of death usually remains unknown—except for the recognition of the sporadic fatal wound or the rare case where evidence of disease such as malignant tumors or severe osteomyelitis justifies a reasonable inference. When there is no firm evidence, specu-

lation takes over: it has been assumed almost universally that the women died younger than the men because of the hazards of pregnancy and childbirth in communities which had only the most rudimentary obstetric skills. That deaths in parturition, or consequent upon it, occasionally occurred, could hardly be doubted on a priori grounds. If doubt exists, it could be dispelled by the evidence of the burial grounds where women's skeletons have been found with fetuses impacted in the pelves. As long ago as 1910 Elliot Smith and Wood Jones recorded two ancient Egyptian cases in which each woman had a deformed pelvis and a fetal head in the pelvic cavity;<sup>3</sup> Møller-Christensen reported a medieval case from Aebelholt, Denmark, of what he calls "coffin birth";<sup>4</sup> Sonia Hawkes and I noted an early Saxon obstetric death from Kingsworthy, Hampshire, in which a woman was buried with a child who seemed to be half in and half out of her vagina;<sup>5</sup> and Sjøvold et al. describe a medieval woman who died in childbirth because her pelvic cavity was obstructed by multiple exostoses.<sup>6</sup> Other examples may be found in the literature of paleopathology, but the interesting feature of these obstetric calamities is their rarity. The few indubitable examples which have been excavated would make virtually no difference to the sex ratio in any of the populations in which they occurred.

It has sometimes been suggested that when an ancient grave is found to contain a woman and a young infant this must represent a puerperal death. As a general proposition this is unjustified. A baby placed on a woman for burial may not be her child; we know far too little about the precise details of early inhumations to be sure about who was buried with whom. When epidemics of plague, typhus, or other infections were taking a heavy toll of a community, a woman and baby could be aunt and nephew or no more than unrelated neighbors in a grave conveniently shared by two bereaved families. Double graves of adults and older children are common in early cemeteries. Only in exceedingly rare cases can archaeological excavation, unsupported by textual evidence, definitely prove a parent-child relation between a woman and a baby buried on her chest, beside her flank, or even between her thighs. Only with the most recent and most meticulous techniques of excavation is it possible to be absolutely certain about the physical relation of two skeletons in a common grave. Until recently, many such archaeological conjunctions were recorded incompetently and interpreted wrongly. Even if we suspend critical judgment and grant that the in-

fant "found above the left shoulder bones of a young adult woman buried in grave no. 48" at Oroszvar was her child, we are not justified in asserting that this was an obstetric death. The woman may have died of pneumonia, typhoid, or other disease independent of her pregnancy.

To assert that the presence of a dead baby implies that it died in a difficult labor is unsound also. If its mother died of some infectious disease the baby may have followed her merely because it was not breast-fed and had to be reared on contaminated cow's milk. We do not know how readily prehistoric women were prepared to act as wet nurses for the infants of dead neighbors: their breasts often may have had insufficient milk to suckle their own babies. But willingness aside, in tiny medieval, Saxon, or neolithic hamlets, especially in the more isolated ones—perhaps separated by difficult mountain terrain from their nearest neighbors in the next valley—there often may have been no lactating woman available as a wet nurse. Hence another infant death would quickly follow the maternal death, although neither would be obstetric in the sense of being caused by hazards of childbirth.

Even in those cases where excavation leaves no doubt that a fetus was in the woman's abdomen, we should not make the unquestioned assumption that this was an obstetric death; the woman could have died of erysipelas or meningitis near the end of her gestation. Perhaps only in those cases in which a full-term infant is found in a deformed or obstructed pelvis can we be nearly 100% certain that the death was actually attributable to the pregnancy. These cases are very uncommon. Acsádi and Nemeskéri record 12 medieval examples from Hungarian sites in which women and infants were buried together.<sup>7</sup> They believe these to be obstetric deaths and use them to draw demographic conclusions. However, a close scrutiny of the combined archaeological evidence and its possible medical implications makes it rash to accept more than two, and perhaps only one, of these cases as genuinely ascribable to parturition. The rest must be judged as unproved or improbable. The accurate assessment of archaeological-plus-gynecological subtleties is much more difficult than some demographers appear to believe. We may wonder, therefore, whether the "hazards-of-childbirth" explanation is not too facile and unsubstantiated to bear critical scrutiny.

It is worth considering briefly what these hazards are likely to have been and how common they were in early communities; paleodemographers seem to have avoided this issue. Deaths from parturition can be

broadly grouped under four causes: obstructed labor, infection, hemorrhage, and miscellaneous.

The commonest cause of *obstructed labor* from the 17th to the early 20th century was rickets which, by producing severe pelvic deformity, impeded the passage of the child. Vast numbers of women in the urbanized parts of Europe and America or secluded under the purdah system of the East had difficult or fatal labors as a result of having what is known as a "rickety flat pelvis." As a cause of obstetric deaths, this must have been exceedingly uncommon before Renaissance times and negligible before the 12th century, owing to the extreme rarity of rickets, which is essentially a disease of malnutrition and lack of sunlight in dark city slums.

Another cause of obstructed labor is an unduly large baby, even when the pelvis is neither small nor deformed. Large size in babies may be due to various causes, one of which is uncontrolled diabetes. Although diabetes has a long history—having been described and named by Aretaeus in the second century A.D.—there is evidence that it was less common in ancient than in postmedieval times. It is reasonable to infer also that the diabetic hazards of difficult labor and the serious postpartum metabolic adjustment required of the mother were less common in pre-Renaissance times. Yet another cause of obstructed labor is malposition of the child *in utero*: a breech birth, transverse lie, or some other abnormality. But these conditions are often caused by a rickety pelvis which prevents the fetus from entering it in the proper manner and so they too—and the deaths they caused—are likely to have been less common in the Middle Ages and earlier epochs. Obstructed labors from such causes as the exostosis multiplex recorded by Sjøvold<sup>6</sup> have always been extremely rare; hydrocephalus hardly could have been much more common.

Deaths from *infection*, the dreaded puerperal fever of the 18th and 19th century childbed, have accounted for innumerable fatalities. Their occasional occurrence in antiquity is attested by classical writers such as Hippocrates, Soranus, Aetius, and Avicenna. However, few labors which in other respects run a normal course give rise to postpartum infection—unless the mother has been in a hospital where many infected persons are congregated and where babies are delivered by obstetricians who attend the birth unwashed, coming straight from gangrenous amputations or septic autopsies. These were the circumstances which made delivery in a

19th century hospital so dangerous and against which Semmelweis and Oliver Wendel Holmes strove so passionately. These conditions accompanying mass hospitalization of parturient mothers were unknown before the 18th century and deaths from puerperal fever must have been much less common as a result. Another common cause of puerperal sepsis was extensive manual or instrumental interference during the course of abnormal labor, even among women delivered in their own homes. The difficult forceps delivery or the use of decapitation hook, crotchet, and cephalotribe — always unsterilized — introduced countless bacteria, damaged the maternal tissues, and almost inevitably led to puerperal sepsis. But here we are going partly around the circle again; a very high proportion, perhaps the major part, of the labors which needed these desperate measures were those associated with rickets and the deformed or contracted pelvis it produced. Hence, once again, these deaths must have been fewer, in the prerickets period of medieval times and earlier, than they later became.

*Hemorrhage* in pregnancy or labor may be due to various causes. The toxemic and accidental bleeding from a normally situated placenta is most commonly caused by pre-eclampsia or eclampsia, forms of a disease in which severe or fatal fits are an outstanding occurrence. Again, there is strongly suggestive evidence that this condition was less frequent in pre-Renaissance times than in the 19th or early 20th centuries. Placenta previa is a condition in which the afterbirth is situated abnormally low in the uterus and which gives rise to dangerous bleeding which is often fatal to the mother and the child. It is more frequent in multiparas than primiparas. Presumably, it would have been less common in early populations if there was any likelihood that they had fewer children than, say, Victorian parents. Other causes of hemorrhage could be cited but need not be discussed here.

*Miscellaneous causes* of deaths from pregnancy include a number of uncommon conditions, many of which probably were as frequent in ancient times as in recent centuries—although no more so.

Thus, it seems highly probable that the hazards of childbirth in Anglo-Saxons and other early people were much less—perhaps only one fifth or one tenth—than they became later. The whole assumption of numerous deaths associated with pregnancy appears to owe its origin and unquestioned acceptance to an atmosphere colored by a proximity to and vivid memory of the appalling obstetric horrors of rickety pelvis

and puerperal fever which were so common in lying-in hospitals in the 19th and even the early 20th century. It is worth recalling here that in Semmelweis' hospital in Vienna the maternal mortality at one time was about 30%! Recently, Grauman<sup>8</sup> has written, "Expectation of life at birth may have been a mere 20-22 years in the Paleolithic, leaving a narrow margin for survival of the species given the limitations to fertility *when hazards of pregnancy and childbirth must have been severe.*" He offers no evidence to support that part of his statement which I have italicized; it seems to be little more than a surmise based on the obstetric conditions of 19th century urban Europe. If there is any truth in what I have written here, it is reasonable to suppose that childbirth was relatively easy and uncomplicated in Paleolithic times, perhaps increasingly so as we look back through *Homo erectus* to *Homo habilis* and *Australopithecus*, although this can be no more than an unverifiable speculation.

If any other factor could be found which might have reduced the incidence of these hazards still further, we soon should have to recognize that the few obstetric fatalities which did occur in ancient populations would have been insufficient to explain the younger age of female deaths, which almost all anthropologists detect. One such factor might be the average number of children produced by the women. This is not a problem that can be solved in the absence of an efficient system of registering births or at least of recording baptisms, but certain general observations can be made. It is often assumed that because ancient peoples knew nothing of the contraceptive pill, French letters, or intra-uterine contraceptive devices, their women must have lived in an almost perpetual state of pregnancy from menarche to menopause or until an earlier death intervened. This is yet another assumption which needs to be questioned.

In the first place, it is certain that contraceptive techniques were known and practised by some early people—and if some why not by many or most? Coitus interruptus, heterosexual sodomy, plugging the vaginal vault with pledgets of linen seeped in salves, grease, etc., and even deliberate abortion were practised, and must have reduced the frequency of conception in at least some women. Hippocrates described abortion. Roman surgical instruments appropriate for performing the operation are described and have been found.<sup>28</sup> The artificial termination of pregnancy may have been an almost worldwide procedure among

early peoples; it has been described in pre-Columbian Peru.<sup>26</sup> Janssens<sup>10</sup> has even noted the skeleton of a Gallo-Roman woman with an instrument in her pelvis which he believes indicates sudden death from air embolism while she was secretly trying to induce a miscarriage. Evidence of the extensive use of abortifacient drugs and other methods also is found in the Anglo-Saxon Penitentials. That of Ecgbert begins: "If a woman kills the child within her with drinks or other things, or kills it after it is born, she is to fast 10 years. . . ." And apart from these drastic measures Helen Cayton points out that "there are included in the *Penitentials* prohibitions and penalties for intercourse at certain periods of the year, mainly related to the Church festivals. These periods are the 40 days of Lent, Advent, three months before Pentecost, three days before taking Communion, Sundays, three months before the birth of a child and 40 days after.

In addition to the antenatal prohibition, more than five months of the year are excluded; this, if adhered to conscientiously by the devout, must have limited conception considerably. No doubt many people preferred to perform the penances, and the full observance of all these taboos may well have been the exception rather than the rule. But the emphasis laid upon them in the monkish texts justifies us in assuming that they were by no means ignored and that even their partial observance must have had an appreciable effect in reducing the frequency of coition and the probability of pregnancy. These prohibitions applied, of course, only to those early communities which had been Christianized, such as the Anglo-Saxons and Burgundians, but many pagan tribes also have had taboos and restrictions on the time and frequency of intercourse.

It is also important to reconsider the frequently made assumption that in earlier times girls became pregnant almost as soon as the onset of menstruation showed them to be physiologically or socially mature. There is abundant evidence in those modern primitive tribes which uninhibitedly indulge in sexual intercourse from early adolescence, as also in societies of the European type, that the menarche does not indicate full sexual maturity or guarantee that pregnancy can occur. It is now realized that in many girls, if not most, menstruation precedes the onset of ovulation, sometimes by several years. There are, of course, numerous exceptions, but many of the girls who start to have intercourse at the age of 14 years or younger are not physiologically capable of producing children until the age of 17, 18, or more years. This has the effect of



reducing the number of pregnancies in girls with small, not yet fully developed pelves and is an important factor in eliminating a potential source of obstructed and difficult labors.

We do not know at what age adolescence occurred in the various archaic populations, although some inferences can be made. Tanner<sup>11</sup> notes that in the 19th century adolescence occurred approximately two years later than it does today. There is a strong probability that in earlier times it may have taken place later still.

Where documentary evidence is available, among upper-class Anglo-Saxon women Helen Cayton found the average age of first pregnancies in the seventh to 11th centuries to be approximately 20 years. If the mean age of female deaths in an early community of this kind was 33 to 35 years, the average reproductive span was only about 15 years. How often, during this span, would women have become pregnant? Again, no unassailable answer can be given: the variation must have been great. After the birth of a child, independently of any postpartum taboos on intercourse, ovulation is suspended in almost all women for a time which may range from three to six months or more. During this anovulatory phase the woman cannot become pregnant. The physiological inhibition of ovulation tends to be more prolonged if the mother breast-feeds her baby. Since many early people probably continued to suckle their children for two or three years, it may not have been unusual for mothers to go as long as this between one pregnancy and the next. If so, with a reproductive span averaging only 15 years they would be likely to produce no more than five or six infants. In a group of 12 named Anglo-Saxon women of the seventh to 11th centuries, Miss Cayton found that they had produced a total of 56 children—an average of 4.6 per woman.

Other circumstances also may have played a part in limiting conception. In some groups the husbands would have been absent from their wives for a significant part of the year, perhaps on seasonal transhumance with herds, perhaps on military forays or seafaring excursions back to the Anglo-Saxon homelands, perhaps further afield as merchant venturers to Gaul, Spain, or beyond.

We are not wholly dependent, however, on these inferences and guesses in attempting to estimate the average number of children borne by these women. As a result of pregnancy and labor, the muscles and ligaments around the pubic region become stretched and torn. Slight bleedings occur at their attachment to the bone and these lead to pitting,

erosion, or irregular exostoses of the pubis. From the extent of these changes, an estimate can be made of the number of pregnancies which a woman has had. In most early European populations where this has been done a figure of four or five is commonly found, seldom more than six or seven, often only one or two. Moreover, Blakely and Walker<sup>12</sup> used this pubic evidence when analyzing pre-Columbian burials from Illinois and came to the conclusion that "... examination of female pelves reveals that multiparous individuals, irrespective of age, were in no greater danger of dying than any other segment of the population." Lorimer<sup>13</sup> made thorough studies of fertility levels in modern populations which used no birth control and found values in the five-to-seven range. The total of childbirths during the entire reproductive period was 6.5 in Bulgaria, 5.3 in Japan, 6.4 in Brazil, and 5.2 in Mexico. All these were in populations with a mean life span—and no doubt a reproductive span—considerably in excess of the earlier populations with which we are concerned here. Allowing for the reduced reproductive period and life span of earlier woman, a reduction of fertility and, hence, of exposure to the hazards of pregnancy, is a likely consequence.

The over-all impression left by all of these considerations is that the number of births per woman was smaller than often has been supposed, that difficult or fatal deliveries were probably uncommon, and, therefore, that the younger mean age of female deaths cannot be correctly attributed to "the hazards of childbirth"—or only very slightly so.

Support for this view may be found obliquely by a consideration of postmenopausal women. If women died younger than men because of deaths which occurred in pregnancy and labor, it might be expected that, when childbearing was safely finished, women would live as long as men—or even longer, as they do today. In early times the menopause probably did not occur much later than 45 years of age. Fertility, however, tends to drop to a low level several years before menstruation stops. The relation between fertility and age has been expressed by Henry as follows:<sup>27</sup>

Age group of females (years)	20 to 24	25 to 29	30 to 34	35 to 39	
Fertility per 1,000 women	494	483	443	389	
He determined the relation of sterility to age as follows:					
Age of women (years)	20	25	30	35	40
Sterile women (%)	3	6	10	16	31

These figures are based on recent data from six European countries. In

TABLE III. AVERAGE AGE AT DEATH OF PERSONS SURVIVING BEYOND 45 YEARS.

<i>Site</i>	<i>Period</i>	<i>Males (Years)</i>	<i>Females (Years)</i>
Cirencester	R. B.	53.3	46.6
Monkwearmouth	Medieval Anglo-Saxon	52.7	48.7
Caerwent	Medieval Anglo-Saxon	49.5	45.1
Jarrow	Medieval Anglo-Saxon	53.2	52.6
North Elmham	Late Saxon	49.6	46.4
Average		51.6	47.8

earlier periods the percentage of sterile women probably rose more sharply and by 40 years was well above Henry's estimate for modern communities. For Anglo-Saxon women, the great majority are likely to have come to the end of their reproductive life by the age of 40; almost all did so by 45 years of age. (This refers, of course, only to those fortunate women who managed to survive to that age.)

Table III shows the average ages at death in a few early communities of those men and women who lived 45 years or more. Even though the women in this group may be presumed no longer to be exposed to parturition, they continued to die younger than the men by an over-all average of 3.8 years; the margin ranged from 0.6 years at Jarrow to 6.7 years at Cirencester. These figures support the suggestion that causes other than pregnancy may underlie the shorter expectation of life of women in early groups. What then can account for this widespread finding?

It is difficult to assess the relative occupational "wear and tear" which affected men and women in the past. No doubt the men hunted and made war, but these—especially the latter—were intermittent or even short seasonal occupations in many communities. The year-round drudgery of agriculture—deforestation, breaking tough soils with clumsy plows and mattocks, harrowing, reaping, breaking in horses, building houses, barns, and palisades, digging ditches, and many other such strenuous tasks—must have imposed heavy strains on the men. Indeed, the abundant evidence of osteoarthritic joints leaves no doubt of this. But life was not light for women either. The endless round of domestic chores—baking, brewing, churning butter, weaving, preparing skins, making clothes and perhaps pots, helping to keep the gardens in good trim, sharing the lighter tasks of building houses, guarding sheep and

geese, cutting osiers and withies to repair fences or make baskets, and innumerable other tasks—left little time for leisure and would have been extremely demanding on a woman's energy and stamina. To cope with all this work these peoples must have needed a high intake of calories and this was not always available. Common sense would lead us to suspect that, having inefficient agricultural methods and lacking effective measures to control epizootics among herds and the pests and blight which could ruin crops, these ancient communities often must have suffered from shortages of meat and grain, the two staple foods of their economy. This guess is abundantly confirmed from literary sources. There are many records throughout the Middle Ages, back into Saxon and Gaulish times and earlier, of famine years when many people were starving and all were hard pressed to find enough for their daily needs. In those years of want, which probably averaged one in five and occasionally came in disastrous spells of three or four years consecutively, people were reduced to the expedient of grubbing roots, chewing tree bark, eating berries, and garnering the seeds of wild grasses. A good account of these famines and the measures taken to survive them can be found in Sayce.<sup>14</sup> Growing children especially were vulnerable to undernourishment, and the effects of infant malnutrition surely remained with many of them throughout life.

It is clear that almost all the early historic peoples of northern Europe—Avars, Alans, Gauls, Goths, Franks, Burgundians, Saxons, Jutes, Vikings—were male-dominated societies: patrilineal, patriarchal, and patrilocal. Because prowess on a battlefield and skill with sword or spear might be required of a man at any time (even if rarely) for the defence of his corral, oppidum, or tribe, it was essential for males to be as fit as possible—not weak from present starvation or previous malnutrition. It is likely, therefore, that in adult life, when they could assert themselves and demand it, the men took the lion's share of the food and were sanctioned to do so by tribal mores. We might guess that in childhood the boys, as potential warriors and the favored sex, were given more generous helpings than their sisters—who probably had to make do with the toughest, poorest cuts of meat and the leftovers of the meal, at least in times of food shortage. Here again, however, we need not rely on guesswork. There are several sources of osteological evidence which confirm the above suggestions.

First, as regards the probability that the women and girls were given

the toughest, least succulent, and presumably least nutritious morsels, there is evidence from a number of Saxon burial grounds that the females had somewhat severer dental attrition than the males, despite the fact that by dying earlier their teeth had had three to six years less use and perhaps were powered by weaker muscles of mastication than those of the men.

As for the likelihood that girls were less well fed than boys, several sources of evidence can be adduced. One of these is the presence of hypoplastic defects in teeth. These are lesions of the enamel in the permanent dentition which are caused by illness or malnutrition in early childhood. The approximate age at which the adverse episode occurred may be inferred by observing which teeth are affected. It is often found to extend over several years, with especial incidence and severity in two-to-four-year olds. Hypoplasia of enamel varies greatly in frequency in early communities. At the Late Saxon village of North Elmham, which yielded 206 burials, it was present to some degree in approximately half of the dentitions; of the 55 sexable skeletons in which it occurred, 39 (70.9%) were female. At Monkwearmouth there was a lower over-all frequency of this condition, but the women still were affected twice as often (25%) as the men (12.2%). Other sites have shown a similar pattern. Where it occurs, the incidence of hypoplasia may be interpreted as indicating a higher rate of infantile illness and malnutrition among the girls than the boys.

More important than hypoplasia of enamel is the evidence given by Harris's lines of arrested growth. This is very important, because it covers a longer period of childhood than that embraced by enamel defects. Harris's lines are transverse zones of calcification, usually detected radiologically, which lie across the shafts of long bones. Their mode of formation need not be discussed here; it will suffice to say that they, too, are caused by episodes of illness or malnutrition occurring during childhood or early adolescence; the lines persist and are recognizable in adult life. Much work has been done on the frequency of Harris's lines in early populations.<sup>15, 16</sup> It has been found that in specimens from many cemeteries the girls had their first growth-arresting episodes at an earlier age than the boys. If exanthemata or other infectious diseases present in the community were causing these lines, it is difficult to suppose that girls would have contracted these diseases two or three years before their brothers were infected. It is also difficult to explain why girls of six to

nine years should have a higher morbidity than boys of the same age if disease caused the distribution and frequency of Harris' lines found in some Anglo-Saxon and other early populations. A much more likely explanation is that the pattern of illness in these children reflects the difference between relatively well-fed boys—the up-and-coming warriors and patriarchs—and the marginally fed or frankly undernourished girls—the future drudges and mothers.

These various lines of evidence therefore suggest that the shorter expectation of life among females may have been caused by chronic malnutrition which probably began in infancy and continued throughout childhood. By the time kitchen duties gave adolescents or young women some command of the cooking pot, it was too late to make up the deficiencies of their early years. Pregnant or not, females remained somewhat undernourished, marasmic, susceptible to iron-deficiency anemia, less resistant to infection than the men, and lacking the reserves of vital energy which might have helped them toward a long life. Skeletal confirmation of this postulated anemia might be recognized in the occurrence of *cribra orbitalia*. This disease is not uncommon in ancient burial grounds from most parts of the world. Among several populations, ranging from 450 to 1100 A.D., lesions of *cribra orbitalia* are nearly three times more frequent in women than in men.

There are, then, several different kinds of osteological evidence which converge to one conclusion: in these ancient societies the girls and women were more likely to suffer from malnutrition than the boys or men and, in consequence, were more susceptible to the semilethal and lethal stresses of their environment. Levels of health and nutrition no doubt varied in early populations, as they do in modern ones, and the suggestions offered here certainly will be more applicable to some groups than to others, although all early populations were affected by them to a great extent.

This interpretation of the difference in expectation of life between the men and women of the majority of the archaic populations—or something very similar to it—seems to be more realistic than previous explanations. This conclusion is in agreement, too, with the general observation of Goldstein<sup>17</sup> that length of life was and is more affected by the culture of a group than by its biology. To pretend that puerperal causes played no part at all in the female mortality of prehistoric or protohistoric times would be foolish, but the considerations discussed here may help

to place the hazards of childbirth in clearer—and much smaller—perspective. It is at least obvious that we should no longer translate Semmelweis' *Wiener Allgemeines Krankenhaus* of 1845 into the Saxon or Neolithic eras and imagine that the resulting picture is a true evocation of what maternity was like in those early times.

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